THE EFFECT OF ACID DEPOSITION ON FUNGI IN FOREST HUMUS

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Introduction

During the growing season 1987 we studied the biology of forest humus in Scots pine forests affected by urban pollution. The amounts of Scots pine ectomycorrhizae, proportions of mycorrhizal fungus symbionts and amounts and activity of mycelium were determined and also certain chemical parameters of the soil organic matter.

Some preliminary results are presented here.

This study is part of the Finnish Research Project on Acidification (Hapro) supported by the Ministry of the Environment.

Study area

The study sites are dry-dryish Scots pine forest stands in the environs of Oulu, Northern Ostrobothnia (Fig. 1). The most important emissions in the city are (Vuononvirta et al. 1984):

SO_2	10 000 - 12 000	tn/year
CO	10 000	
NO_x	7 000 - 8 000	
dust	7 000 - 8 000	
H_2S	1 200	
Pb	20	
Hg	0,2	

Twenty sites are located in pollution zones determined by reference to the sulphur content of Scots pine needles (Karhu 1986):

sites	zone	needle S cont.
11-15	1	not determined
21-25	2	<1100 ppm
31-35	3	1100-1300 ppm
41-45	4	>1300 ppm

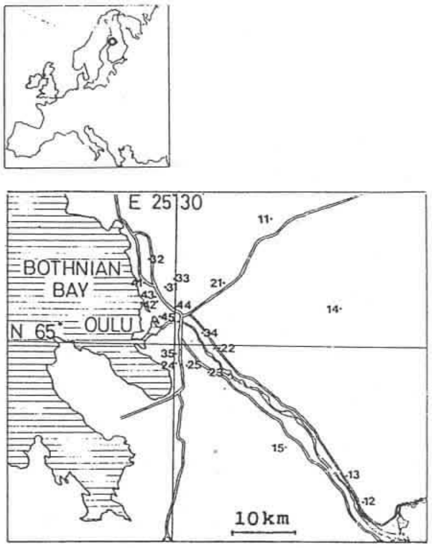


Fig. 1.

Study area and sites. Lines indicate the main roads.

Methods

Random humus cores were taken monthly at each site. Pine mycorrhizae were counted under a dissection microscope separately for each humus core. A mixed sample of 15-35 cores without roots were used for the other determinations.

Soil respiration rate was measured by the static chamber method (de Jong et al. 1979).

The pH of samples was measured in a soil - 0,01 N $CaCl_2$ extract (1:2, by volume)

Total nitrogen was determined by the micro-Kjeldahl method with tube digestion (Kubin 1978).

Total sulphur was determined by x-ray fluorescence analysis (Huttunen et al. 1985)

Results and discussion

Total sulphur and nitrogen in the soil organic layer were distinctly higher in the central city area than in the suburban and background areas (Fig. 2), and pH was also slightly higher in the centre (Fig. 2). On the contrary, biological activity expressed as the rate of humus respiration was lower in the most polluted zones than at the cleaner sites (Fig. 4). The deposition of air pollutants may also affect the degradation of humus organic matter. The humus layer was generally thicker in the heavily polluted area, on average 6.6 and 7.1 cm in zones 3 and 4 respectively as compared with 3.8 and 4.4 cm in zones 1 and 2 respectively.

The ectomycorrhizae of Scots pine were slightly poorer and the roots less ramified in the city centre (Fig. 4). The number of mycorrhizal types was lower in the polluted areas. Some types, especially rhizomorphous ones (Piloderma croceum, Dermocybe, Hebeloma and Type 03), seemed to suffer from pollution, whereas ectomycorrhizae formed by Cenococcum geophilum were even more abundant in the city area (Fig. 3).

The changes in ectomycorrhizal involvement could be partly due to excess nitrogen. The depressive effects of other air pollutants in the humus layer, especially sulphur compounds cannot be excluded.

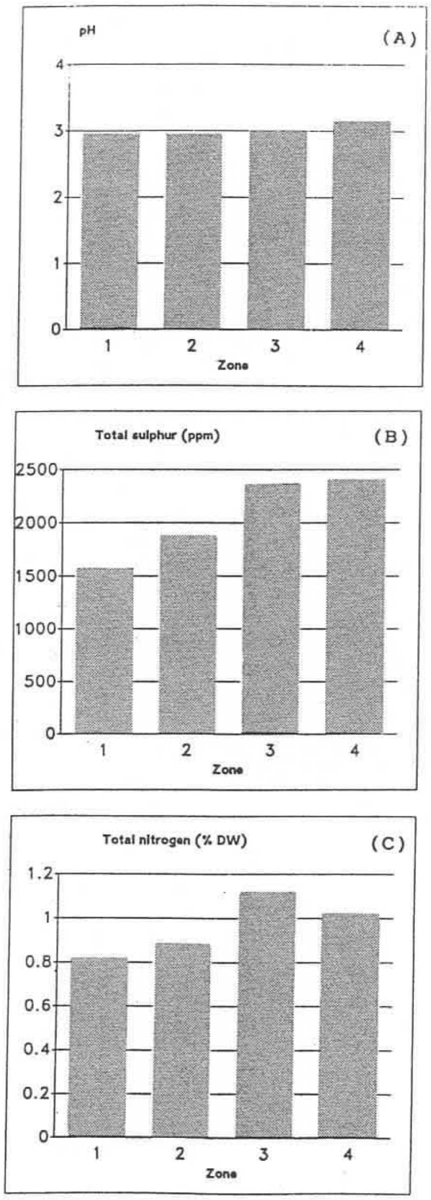


Fig. 2.
pH (A), total sulphur content (B) and total nitrogen content (C) of the humus layer in the pollution zones. Values are means of samples collected monthly (1.6.-11.10. 1987).

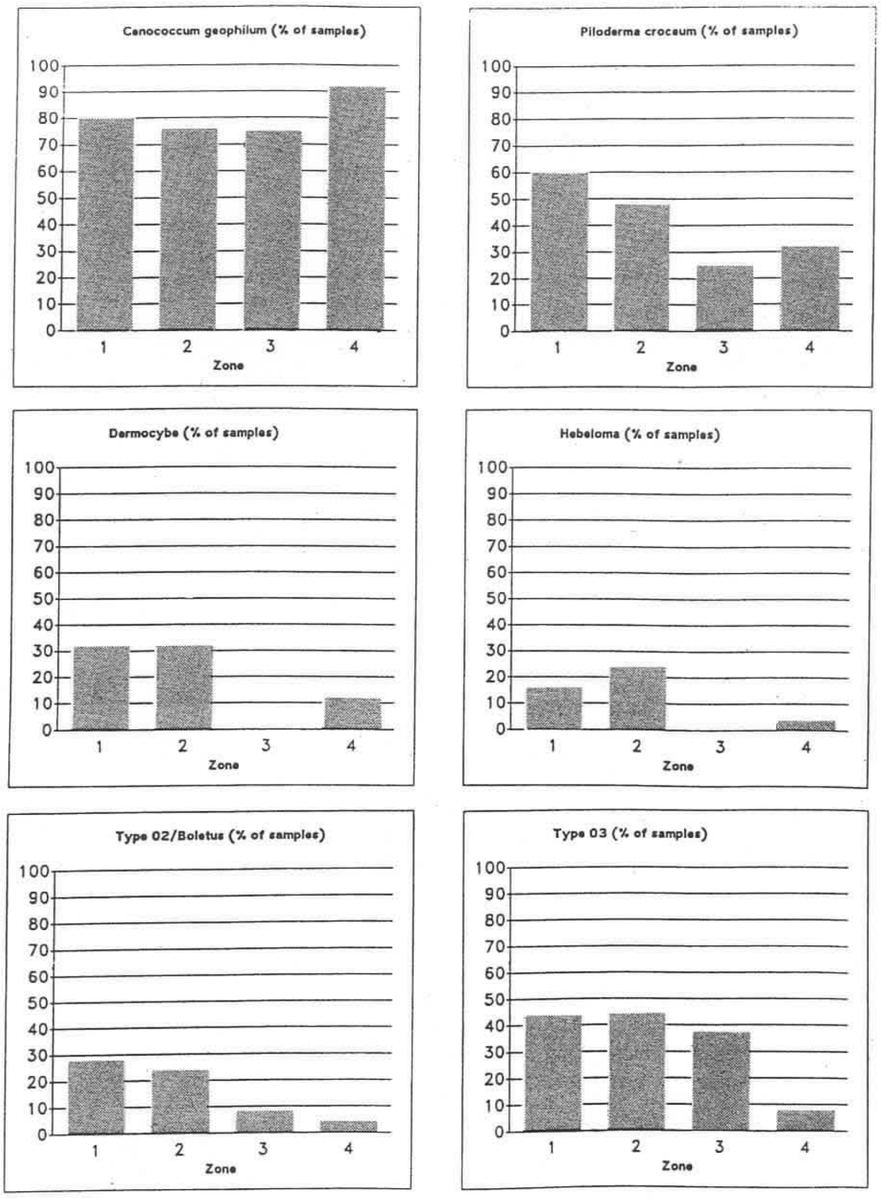


Fig. 3.
Occurrence of some ecto-mycorrhizal types in the samples collected on 7.-14.9. 1987.

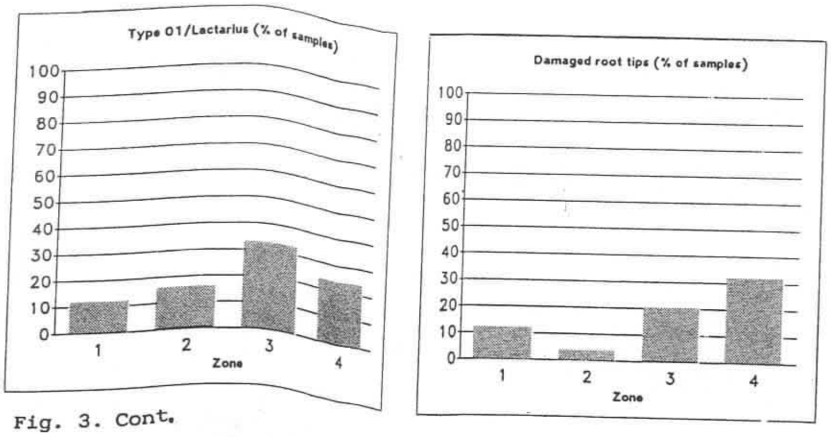
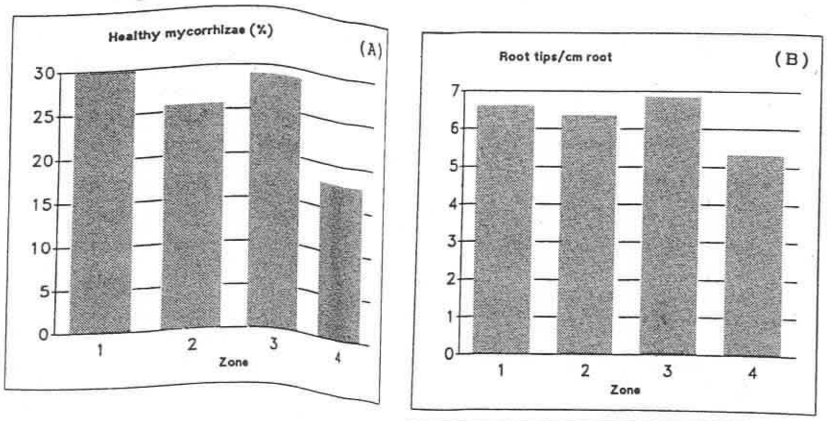


Fig. 3. Cont.



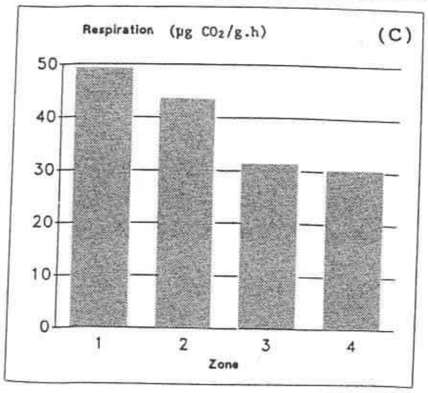


Fig. 4. Percentages of healthy ectomycorrhizae of Scots pine (A), and numbers of pine root tips/cm root (B) in the pollution zones. Values are means from five cores from each site collected on 7.-14.9. 1987. Soil respiration (C) as means of samples collected monthly (1.6.-11.10. 1987).

Conclusions

Higher in the centre

- total sulphur and nitrogen in the soil organic layer
- pH
- number of ectomycorrhizae formed by Cenococcum geophilum

Lower in the centre

- biological activity
- health of ectomycorrhizae
- root ramification
- number of mycorrhizal types
- number of rhizomorphous types of mycorrhizae

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